

Descriptions of two new *Cephalaeschna* species from Yunnan, China (Odonata: Aeshnidae)

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Two new species, *Cephalaeschna cornifrons* sp. nov. and *C. ordopapiliones* sp. nov. from Yunnan Province, China, are described, illustrated in color and compared with known Chinese *Cephalaeschna*. All the holotypes are deposited in the Collection of Aquatic Animals, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan City, Hubei Province, China. Brief notes on biology of each species are also provided.

Keywords: Odonata; dragonfly; *Cephalaeschna*; new species; Yunnan; China

Introduction

Southwestern China is a hotspot of biodiversity. It is home to many flagship animals, the most famous being the Giant Panda. Owing to the complex terrain and the mild climate, it is also a paradise for insects.

In a winter expedition (November–December 2012) to the famous Cangshan mountains, in the Bai Autonomous Prefecture of Dali, west Yunnan Province, some very remarkable dragonflies were encountered. The mountains, with Malongfeng (4022 m) the highest peak, are covered by dense vegetation mixed with coniferous and broad leaved forest. Valleys support an extremely rich system of streams, rivers and marshes, providing ideal habitats for Odonata. Our survey was conducted mainly between 1600 and 3000 m altitude. The winter sunshine was so intense that many dragonflies were still on the wing in December, including members of the genera *Cephalaeschna*, *Planaeschna*, *Megalestes*, *Sympetrum*, *Crocothemis* and *Orthetrum*. Two new *Cephalaeschna* species were discovered, and are named here. Our exploration of the region is continuing, and hopefully will improve our presently limited knowledge of the fauna, as well leading to the discovery of more undescribed taxa.

Both holotypes are deposited in the Collection of Aquatic Animals, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan City, Hubei Province, China.

Abbreviations of abdominal maculation, adopted from Walker (1912) include: S = abdominal segment, AD = anterodorsal, AL = anterolateral, MD = mediodorsal, PD = posterodorsal, and PL = posterolateral.

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Descriptions of new species

Cephalaeschna cornifrons sp. nov.

Material examined

Holotype: male (2012YN03-009), Fengweiqing, Wase Town, 25.92°N, 100.29°E, altitude 2328 m, Bai Autonomous Prefecture of Dali, Yunnan Province, China, Haomiao Zhang leg., 21 October 2012; **Paratypes:** 1 female (2012YN03-012), same as holotype; 2 males (2012YN03-010; 2012YN03-011), same locality and collector, 18 October 2012; 3 males, 1 female (2007YN003;

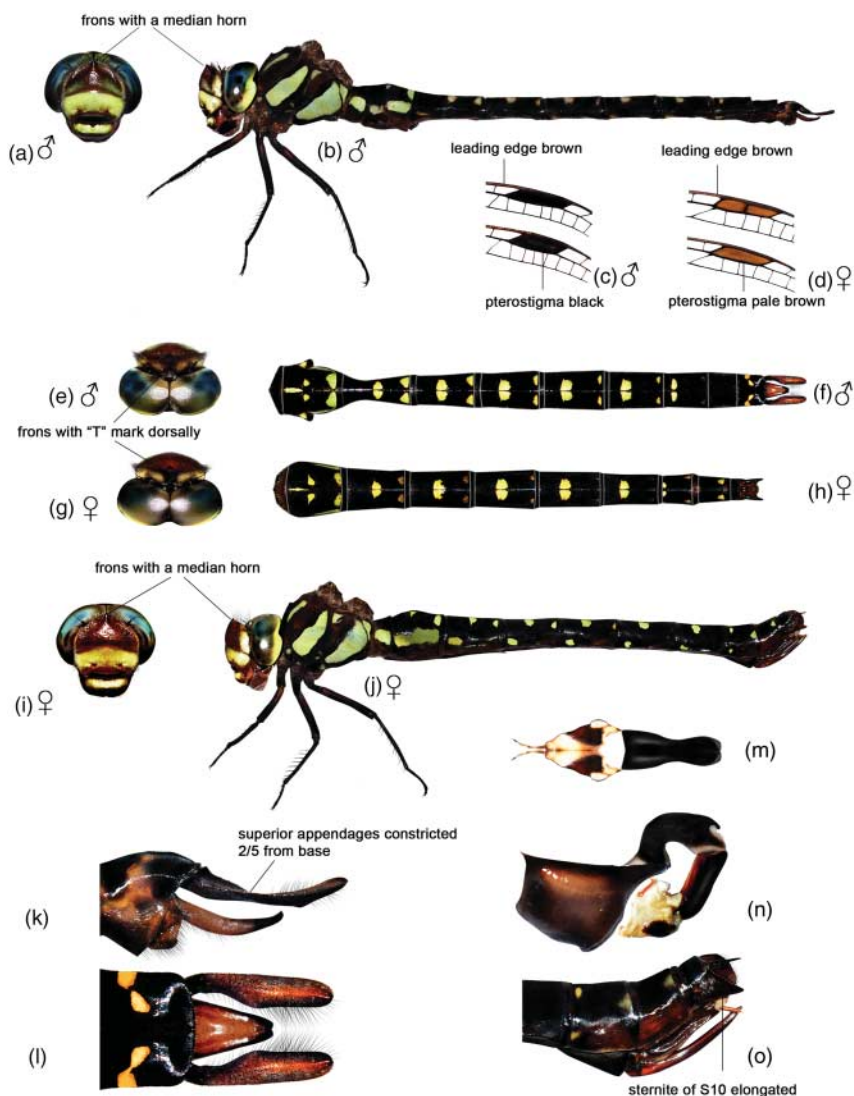


Figure 1. *Cephalaeschna cornifrons* sp. nov., holotype male (a–c, e–f, k–n) and paratype female (d, g–j, o): (a) head in frontal view; (b) body in lateral view; (c–d) leading edge of wings and pterostigma; (e) head in dorsal view; (f) abdomen in dorsal view; (g) head in dorsal view; (h) abdomen in dorsal view; (i) head in frontal view; (j) body in dorsal view; (k) appendages in lateral view; (l) appendages in dorsal view; (m) penis in ventral view; (n) penis in lateral view; (o) ovipositor.

2007YN005; 2007YN006; 2007YN007), Qingbixi, Mt. Cangshan, 25.65°N, 100.14°E, altitude 2700 m, Bai Autonomous Prefecture of Dali, Yunnan Province, China, Haomiao Zhang leg., 27 August 2007.

Etymology

The name *cornifrons*, meaning “horn face”, derived from Latin *cornu* = horn and *frons* = forehead; signifying the unique median horn on the frons in both sexes, which is the remarkable character by which this new species may be recognized.

Holotype (male)

Head. With eyes in life mainly luminous dark blue with the posterior margin yellow (Figure 1a, b, e). Labium brown, with sparse black setae. Labrum yellow with lower edge pale brown. Anteclypeus dark brown. Postclypeus yellow with lower edge brown. Frons fundamentally greenish yellow with dense marginal setae, about 2/3 width of head, with large brown inverted “V” mark in frontal view (Figure 1a) and dark brown “T” mark dorsally (Figure 1e), and lower edge with broad brown margin. Anterior ridge of frons prominent with a distinct median horn, easily seen in frontal (Figure 1a) and lateral view (Figure 1b). Occiput mainly black, fringed with long black setae.

Prothorax. Mainly pale brown. Synthorax chocolate brown with pale green stripes (Figure 1b); dorsal carina entirely dark brown; dorsal stripes on mesepisternum roughly triangular and bent slightly outwards; mesepimeron with broad stripe tapering towards wing base; metepisternum with triangular spot near its upper margin; metepimeron with broad triangular patch. Legs mainly dark brown with femora reddish brown basally (Figure 1b).

Wings. Hyaline, slightly tinted with smoky brown. Triangle 4 or 5-celled in forewings, 5-celled in hind wings, anal loop 12 or 14-celled, anal triangle 3-celled. Basal space with 5 cross veins in forewings and 4 in hind wings. Leading edge of wings brown, pterostigma black with well braced vein in the right wings and poorly braced vein in the left wings (Figure 1c). Nodal index: 16: 25: 24: 17 / 18: 18: 17: 18.

Abdomen. Mainly black with yellow or greenish yellow markings (Figure 1b, f): S1 with large lateral rectangular spot; S2 reddish brown, dorsally with lanceolate AD spot, paired triangular MD spots and paired semicircular PD spots; laterally S2 with comma-shaped spot above auricle and rectangular PL spots separated from PD spots; auricle brown in dorsal view and dark brown in lateral view; S3–S8 with paired MD spots, PD spots and very small AL spots, the MD spots irregular in shape on S3–S7 and linear on S8, PD spots progressively smaller apically and very poorly defined on S8. S9 wholly black. S10 with pair of oblique MD spots.

Superior appendages. Brown, about 1.5 times as long as S10. In lateral view, curved upwards, narrowed before midpoint, about 2/5 distance from the base (Figure 1k); in dorsal view, expanded in apical 3/4, with rounded apex (Figure 1l). Inferior appendage pale brown, apex slightly bifid in dorsal view and the tip turned upwards in lateral view, about 3/5 length of superior appendages (Figure 1k).

Penis. Black and brown, the prominence on the stem slightly hooked (Figure 1n), the distal segment with a pair of slim flagella (Figure 1m).

Paratype (female)

Head. With eyes dark green in life (Figure 1g, i, j). Labium, labrum and clypeus similar to male. Frons reddish brown, pale yellow posteriorly, with dense marginal setae, about 2/3 width of head; mainly brown in frontal view (Figure 1i) and with distinct dark brown “T” mark dorsally

(Figure 1g). The anterior ridge of frons with prominent median horn even more developed than in male. Occiput mainly black, fringed with long black setae.

Thorax. Very similar to that of male (Figure 1j).

Wings. Hyaline, slightly tinted with smoky brown. Triangle 5-celled in all wings, anal loop 8 or 9-celled. Basal space with 5 cross veins in forewings and 4 in hind wings; Leading edge of wings brown, pterostigma pale brown, with well braced vein in all wings (Figure 1d). Cross vein present in pterostigma in left forewing. Nodal index: 18: 22: 22: 17 / 18: 15: 15: 20.

Abdomen. Mainly black with yellow markings (Figure 1h, j): S1, S2 and S8–S10 laterally reddish brown; S1 with large lateral rectangular spot; dorsally S2 with linear AD spot, paired comma-shaped MD spots and paired semicircular PD spots; laterally S2 with broad rectangular spot; S3–S7 with paired MD spots, PD spots and very small AL spots, MD spots irregular in shape, PD spots progressively smaller apically and very poorly defined on S7; S8 with very small AL spots, AD spots and triangular PD spots; S9 with triangular PD spots; S10 with pair of oblique MD spots. S10 with the sternite elongated ventrolaterally to form a tapered prominence (Figure 1o). Ovipositor long but not extending beyond the apex of the superior appendages, reddish brown in color.

Superior appendages. 1.5 times length of S10.

Variation in paratypes

The paratypes collected in August 2007 have greenish yellow stripes, more brilliant in the body color than the holotype and paratypes collected in November, which are rather aged. One paratype male (2012YN03-011) possesses reduced abdominal yellow spots: S6 and S7 without PD spots, S10 entirely black. Frons viewed from the front darker than in the holotype male. The paratype male (2012YN03-010) possesses well developed abdominal yellow spots: yellow markings on S3–S8 larger than holotype, and S9 with paired PD spots.

Measurements (mm)

Holotype male: total length 66.0; abdomen (including anal appendages) 50.5; hind wing 40.5. Paratype female: total length 60.0; abdomen (including anal appendages) 44.5; hind wing 42.5. Paratype males: total length 63.5–65.0; abdomen (including anal appendages) 47.5–50.5; hind wing 40.0–41.5.

Distribution

China (Bai Autonomous Prefecture of Dali, Yunnan).

Notes on biology

The species was first observed in August 2007. A small group was flying near the Qingbixi stream in the afternoon in the Cangshan National Nature Reserve, it was cloudy with intermittent sunshine. Most of individuals were foraging about 4–8 m above the water. The Qingbixi stream is about 5–10 m wide and rather open, with very fast flowing water. This habitat is different from the type locality, Fengweiqing, a rather narrow (0.5–1 m width) and shallow stream. In late November, adults were active on the sunny afternoons, when there was also usually a strong wind. The males patrolled along the stream, and sometimes could be seen holding their territory by hovering very close to the water surface (this behavior was seen between 1400–1600 h, when the air temperature was 19.5–22.5°C). Larvae were also abundant at the type locality. A female was observed to lay

the eggs into the mud on the shore of the stream, changing position every 15–20 seconds. A rather young male was collected in the end of November, indicating that the species can fly until the beginning of December. Some larvae co-occurring at the type locality included *Mnais gregoryi*, *Davidius* sp., *Anotogaster* sp. and *Neallogaster* sp.

***Cephalaeschna ordopapiliones* sp. nov.**

Material examined

Holotype: male (2012YN03-004), Fengweiqing, Wase Town, 25.92°N, 100.29°E, altitude 2328 m, Bai Autonomous Prefecture of Dali, Yunnan Province, China, Haomiao Zhang leg., 18 October 2012; Paratypes: 2 males (2012YN03-003; 2012YN03-006), same data as holotype; 3 males (2012YN03-005; 2012YN03-007; 2012YN03-008), same locality and collector, 21 October 2012.

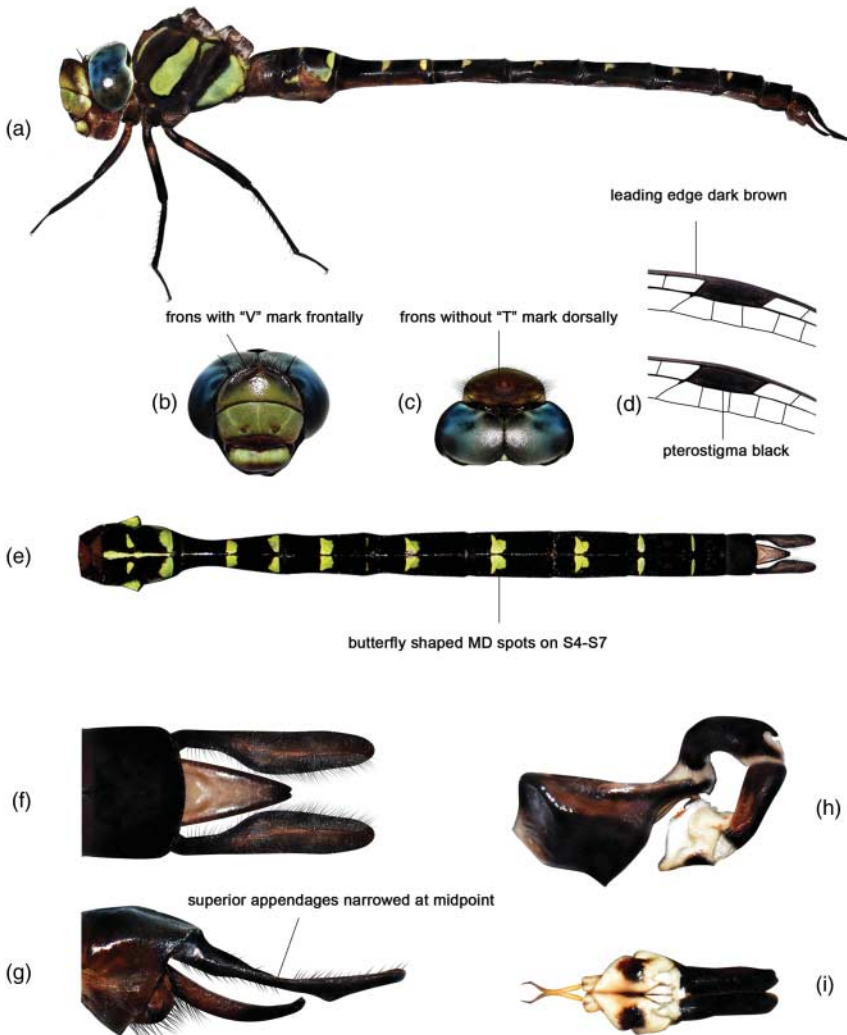


Figure 2. *Cephalaeschna ordopapiliones* sp. nov, holotype male: (a) body in lateral view; (b) head in frontal view; (c) head in dorsal view; (d) leading edge of wings and pterostigma; (e) abdomen in dorsal view; (f) appendages in dorsal view; (g) appendages in lateral view; (h) penis in lateral view; (i) penis in ventral view.

Etymology

The name *ordopapiliones* means “a row-of-butterflies”, derived from Latin *ordo* = line, row, and *papilio* = butterfly; referring to the butterfly-shaped yellow spots on abdominal segments 4–7, unique to this species.

Holotype (male)

Head. With eyes in life mainly dark blue with the posterior margin whitish (Figure 2a–c). Labium brown, with sparse black setae. Labrum greenish yellow, with lower edge light brown. Anteclypeus dark brown. Postclypeus greenish yellow with pair of small brown pits. Frons fundamentally greenish yellow with dense marginal setae, about 3/5 width of head, with large brown inverted “V” mark in frontal view (Figure 2b), lacking “T” mark dorsally (Figure 2c). Anterior ridge of frons prominent, with median point, not produced (Figure 2a). Occiput yellow, fringed with long black setae.

Prothorax. Mainly pale brown. Synthorax chocolate brown with greenish yellow stripes (Figure 2a): dorsal carina entirely brown; dorsal stripes on mesepisternum elongate triangular and slightly bent outwards; mesepimeron with broad stripe; metepisternum with subtriangular spot near upper margin; metepimeron with broad patch. Legs mainly dark brown (Figure 2a): coxae and base of femora reddish brown; tibiae, tarsi, and claws black.

Wings. Hyaline. Triangle 5-celled in all wings, anal loop 12-celled, anal triangle 3- or 4-celled. Basal space with 4 or 5 cross veins in forewings and 4 in hind wings; leading edge of wings dark brown, pterostigma black (Figure 2d), well braced. Nodal index: 15: 22: 24: 17 / 20: 18: 17: 20.

Abdomen. Mainly black, with greenish yellow spots (Figure 2a, e): S1 and side of S2 reddish brown; S1 unmarked; S2 with dorsal linear yellow stripe on median carina, extending from base to apex of segment, paired triangular MD spots and paired semicircular PD spots; laterally S2 with triangular mark above auricle and irregular PL spots which connect with PD spots; small ventrolateral mark ahead of auricle; auricle yellow in dorsal view and dark brown in lateral view; S3 with paired MD spots and PD spots; S4–S7 with butterfly-shaped MD spots; S8–S9 with paired linear AD spots; S10 entirely black.

Superior appendages. Dark brown. In lateral view, curved slightly upwards, narrowed at mid-point and with angled bulge on lower edge near the tip (Figure 2g); in dorsal view, expanded in apical 3/4, with rounded apex (Figure 2f). Inferior appendage reddish brown, apex bifid, 3/5 length of superior appendages (Figure 2g).

Penis. Dark brown, prominence on the stem slightly hooked (Figure 1h), distal segment with a pair of slim flagella (Figure 1i).

Variation in paratype male

The paratype male has very fine PD spots on S4, and S9 without AD spots.

Distribution

China (Bai Autonomous Prefecture of Dali, Yunnan).

Notes on biology

Cephaeschna ordopapiliones also inhabits very narrow (0.4–1.2 m) and open montane streams. The behavior of the species is very similar to *C. cornifrons*, but they were encountered earlier in

the day. Males of *C. ordopapiliones* usually appeared after 1000 h, and were on the wing until late afternoon. They usually flew rapidly around streams in the morning, but never remained close to them. Sometimes they rested on trees. However, in the afternoon, territorial behavior could easily be observed. All specimens collected in November were very aged, suggesting their flight period finishes at the end of November. The species is presently only known from the type locality.

Discussion

Compared with the congeners known from the Himalayas (Asahina, 1981a), Vietnam (Karube, 2003, 2011) and China (Asahina, 1981b, 1982; Wilson & Xu, 2008; Xu, 2006; Zhang, Cai, & Liao, 2013), *C. cornifrons* and *C. ordopapiliones* are distinguished by the median horn on the frons and the butterfly-shaped abdominal spots, respectively. This far *C. ordopapiliones* is known from just one locality whereas *C. cornifrons* is distributed over a wider range (Figure 3). This area is still

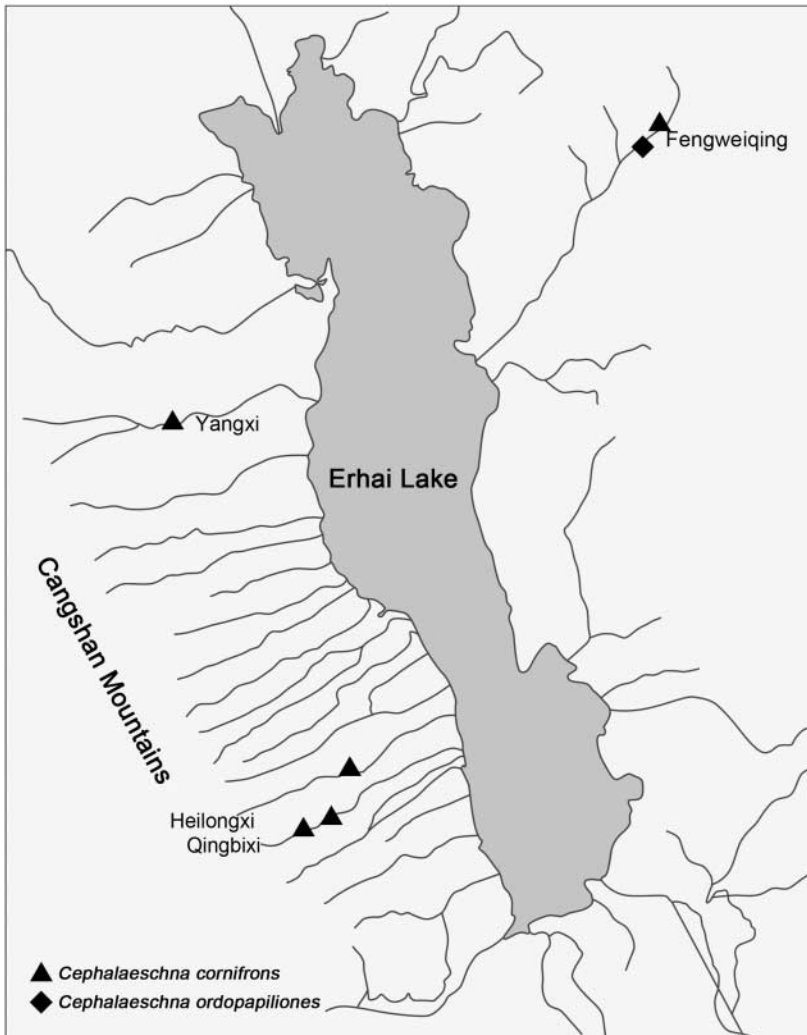


Figure 3. Distribution map of *Cephalaeschna cornifrons* and *C. ordopapiliones* in Dali, Yunnan, China.

Table 1. Comparison of characters of males of *Cephalaeschna cornifrons*, *C. ordopapiliones*, *C. patrorum* and *C. solitaria*.

Character	<i>C. cornifrons</i>	<i>C. ordopapiliones</i>	<i>C. patrorum</i>	<i>C. solitaria</i>
Anterior ridge of frons	With a distinct median horn	With a median point, not produced	With a median point, not produced	With a median point, not produced
Top of frons	With “T” mark	Without “T” mark	With “T” mark	With “T” mark
S4–S7	MD spots irregular, PD spots triangular	MD spots butterfly shaped, PD spots absent	MD and PD spots linear	MD triangular and PD spots rounded
Superior appendages in lateral view	Constricted 2/5 from base	Narrowed at midpoint	Constricted 2/5 from base	Narrowed at midpoint
Stem of penis	With a robust and not obviously hooked prominence	With a robust and not obviously hooked prominence	With a slim and strongly hooked prominence	With a robust and not obviously hooked prominence

very inadequately surveyed and further exploration would be useful to reveal the distribution as well as the biology of both new species.

The two new species are related to *Cephalaeschna patrorum* Needham, 1930 and *C. solitaria* Zhang et al., 2013. Males of the four species have blue eyes, a broad frons about 3/5–2/3 the width of the head, and similar structure of the caudal appendages and the penis. Females of *C. cornifrons* and *C. patrorum* possess an elongated sternite of S10, and females of *C. ordopapiliones* and *C. solitaria* are still unknown, but it is predicted that their females also possess a similar structure of S10. The meaning of the names of *C. cornifrons* and *C. ordopapiliones* provide useful clues to separate them from all the other species of the genus. Viewing the male superior appendages laterally, *C. ordopapiliones* has an angled bulge in the lower edge near the tip, which is not evident in the other three species, and in *C. cornifrons* the superior appendages are more expanded towards the base. Characters of the four species are compared in Table 1.

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